CLAIMS

1. A Solid-state imaging device comprising:

a plurality of pixels each including a light-receiving portion, a wiring layer including a plurality of wirings and a plurality of lenses formed above said light-receiving portions, wherein at least one of said plurality of lenses is an intra-layer lens including a first layer with a concave portion formed by etching and a second layer formed to bury said concave portion.

2. A solid-state imaging device according to claim 1, wherein said wiring layer includes at least a first wiring and a second wiring formed on both sides of said light-receiving portion; said first wiring and second wiring are differently positioned with respect to the distance from said light-receiving portion; and said intra-layer lens is positioned between said first wiring and said second wiring.

3. A solid-state imaging device according to claim 2, wherein said first wiring and second wiring are integrally formed and are connected to a predetermined voltage source.

4. A solid-state imaging device according to claim 1, wherein each of said pixels includes a charge readout transistor and a planarizing film which covers a gate electrode

of said charge readout transistor to be planarized, and said plurality of wirings are formed above said planarizing film.

5. A solid-state imaging device according to claim 1, wherein said first layer is an insulation layer formed to directly cover said plurality of wirings to constitute said wiring layer.

6. A solid-state imaging device according to claim 1, wherein said first layer is an insulation layer formed on said wiring layer.

7. A solid-state imaging device according to claim 1, wherein in a pixel farther away from the center of an imaging region, the center of said intra-layer lens is formed, being biased from above the center of said light-receiving portion to the center side of said imaging region.

8. A solid-state imaging device according to claim 1, wherein at least one of said plurality of lenses is an on-chip lens formed above said intra-layer lens.

9. A solid-state imaging device comprising:

a plurality of pixels each including a light-receiving portion, a wiring layer including a plurality of wirings and a

plurality of lenses formed above said light-receiving portion, wherein at least one of said plurality of lenses is an intra-layer lens including a first layer with a convex portion formed by etching and a second layer formed to cover said convex portion.

10. A solid-state imaging device according to claim 9, wherein said wiring layer includes at least a first wiring and a second wiring formed on both sides of said light-receiving portion; said first wiring and said second wiring are differently positioned with respect to the distance from said light-receiving portion; and said intra-layer lens is positioned between said first wiring and said second wiring.

11. A solid-state imaging device according to claim 9, further comprising a third layer formed between said first and said second layers to cover said convex portion.

12. A method for manufacturing a solid-state imaging device comprising the steps of:

forming a plurality of light-receiving portions on the surface of a substrate; forming wirings on both sides of each of said light-receiving portions; forming a first insulation layer having a first refractive index; etching said first insulation layer by using an etching mask and forming a concave portion

above each of said light-receiving portions; and forming a second insulation layer with a second refractive index to bury said concave portion.

13. A method for manufacturing a solid-state imaging device according to claim 12, further comprising the steps of: prior to the step of forming said wirings,

forming a charge readout transistor; forming a gate electrode to operate said charge readout transistor; and forming a planarizing film which covers said gate electrode to be planarized, wherein said wirings and said concave portions are formed above said planarizing film.

14. A method for manufacturing a solid-state imaging device comprising the steps of:

forming a plurality of light-receiving portions on the surface of a substrate; forming wirings on both sides of each of said light-receiving portions; forming a first insulation layer with a first refractive index; forming a reflow film with a convex surface at a position corresponding to the position of said light-receiving portions above said first insulation layer; etching back said first insulation layer with said reflow film and transferring said convex surface onto said first insulation layer; and forming a second insulation layer with a second refractive index on said first insulation layer.

15. A method for manufacturing a solid-state imaging device according to claim 14 further comprising the step of: forming a third insulation layer to cover said convex surface of said first insulation layer prior to the step of forming said second insulation layer.

16. A solid-state imaging device comprising:

a plurality of pixels arranged each including a light-receiving portion and a MOS transistor, wherein a single intra-layer lens is formed corresponding to each of said light-receiving portions.

17. A solid-state imaging device according to claim 16, wherein part of uppermost layer wirings formed above said light-receiving portions are positioned on both sides of each of said light-receiving portions.

18. A solid-state imaging device according to claim 16, wherein the center of said intra-lens is biased to the center side of an imaging region from the center of said light-receiving portion, when approaching the periphery of the imaging region.

19. A solid-state imaging device according to claim 16,

wherein part of the uppermost layer wirings positioned on both sides of said light-receiving portion are asymmetrically disposed with respect to said light-receiving portion, and said intra-lenses are formed without being affected by said asymmetrical wirings.

20. A solid-state imaging device according to claim 16, wherein said wirings are formed of metallic materials including Al.

21. A method for manufacturing a solid-state imaging device comprising the steps of:

forming wirings on a semi-conductor region in which a plurality of pixels each including a light-receiving portion and a MOS transistor are arranged through an insulation layer with the light-receiving portion in between; forming a first insulation layer with a first refractive index across the whole surface thereof; selectively removing said first insulation layer with a etching mask by isotropic-etching at a position corresponding to said light-receiving portion to form a concave portion corresponding to each light-receiving portion; forming a second insulation layer with a second refractive index across the whole surface including said concave portion; and planarizing said second insulation layer and making the second insulation layer remain within said concave portion to form a

single intra-lens using said first and second insulation layers.

22. A method for manufacturing a solid-state imaging device comprising the steps of:

forming wirings on a semi-conductor region in which a plurality of pixels each including a light-receiving portion and a MOS transistor are arranged through an insulation layer with the light-receiving portion in between; forming a first insulation layer with a first refractive index across the whole surface thereof; forming a reflow film with a convexly curved surface at a position corresponding to the respective light-receiving portions on said first insulation layer; etching back said first insulation layer with said reflow film to transfer said convexly curved surface onto said first insulation layer; and forming a planarizing film with a second refractive index on said first insulation layer to form a single intra-layer lens including said first insulation layer and said planarizing film.